

The Canadian Entomologist.

VOL. XXI.

LONDON, APRIL, 1889.

No. 4.

DESCRIPTION OF THE PREPARATORY STAGES OF ARGE GALATHEA, LINN., WITH NOTES ON CERTAIN SATYRINÆ.

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EGG.—Sub-ovoid, broadest on lower third, the base flattened; covered with a very slight rhomboidal network over the upper third, with low knobs at the angles; on the middle the network is still more slight, but the knobs are distinct, and on the lower third the knobs are minute and unconnected by lines; summit flattened, concave; the micropyle in centre of very fine network without knobs; colour bone-white. Duration of this stage about 20 days.

YOUNG LARVA.—Length, at 12 hours from the egg, .1 inch; thickest anteriorly, tapering to .3, which ends in two short sub-conical tails; colour yellow, with a tint of red; the tubercles arranged as in *Erebia*, forming three longitudinal rows on either side; these are small, conical, each with a long curved whitish hair; feet, legs and under side same colour as upper surface; head sub-globose, broader than .2, granulated, with a few whitish points and long hairs; colour brownish-yellow. The larvae hibernated from the egg.

After First Moult.—Length at 12 hours, .18 inch; colour yellow-buff; a narrow pinkish mid-dorsal stripe, a sub-dorsal same width, then as much of buff on side, and a broad pinkish stripe to the basal ridge, which is yellowish; under side, feet and legs, yellow-brown; body covered with a downy coat of yellowish hairs from fine points, and among them on each segment are black hairs from larger and darker tubercles; head sub-globose, yellow-brown, with yellow and black hairs like those of body. Duration of this stage 11 days.

After Second Moult.—Length .3 inch; stout; yellow-buff; a darker mid-dorsal stripe, and a similar broad lateral band; the basal ridge paler than the ground; under side greenish-buff; thickly covered with buff hairs; head green-buff. Duration of this stage 10 days.

After Third Moult.—Length .65 inch. At nine days from this moult was full grown.

MATURE LARVA.—Length 1.1 inch ; stout ; thickest at 4 and 5, tapering rapidly to 13, and ending in two short sub conical tails ; colour buff the dorsal area of a yellow tint, the sides reddish ; the under side a green tint up to the red-buff ; feet and legs same ; a brown mid-dorsal stripe ; on side the band a shade darker than the ground ; the basal ridge lighter, or yellowish ; body thickly covered with rather stiff, long hairs ; head small, sub-globose, a little depressed at top ; colour greenish-buff, with many buff tubercles and hairs both long and short. (Fig. 1.)

Soon after, the colours became paler, the bands faded, and the larva was lethargic, eating nothing, but lying at the top of the sod curved like a figure 6. At 18 days from third moult pupated in the grass, unattached.

CHRYsalis.—Length .54 inch ; breadth at mesonotum .18 inch, across abdomen .24 inch ; abdomen remarkably stout (one-third broader than the anterior segments), conical, but irregularly so, the ventral side and the whole body up to thoracic segments being greatly swollen, while on dorsum the curve is slight, and rises no higher than does the mesonotum ; this last is very low, rounded both ways ; the head case short, rounded at end, rounded transversely and at the corners ; at each shoulder, over the thoracic spiracle, a black-brown, corrugated shell-like process standing out obliquely and quite prominent, in the middle sometimes a little separated from the surface of the body ; cremaster short, bluntly pointed, on dorsal side having same curve with abdomen, on ventral side excavated, with the edges thickened, horse-shoe shaped, and having at the end a brush of short, stiff bristles, straight, not the least hooked. (Figs. 3, 4, 5 to 8.) Duration of this stage 14 days.

This pupa is very like that of *Eudamus Tityrus* and *Lycidas* ; the same dorsal and ventral outlines, same slope from mesonotum to top of head, same form of head case ; and the thoracic spiracle protector (Fig. 8), as Mr. Scudder calls it, is similar in both ; in *Galathea* this process is more curved and shell-like, and a little more projected from the surface, but they are essentially of same character.

GALATHEA flies in Europe and Algeria, according to Kirby. It is prettily checkered in black and white, has a slender body, and large wings in proportion, as in most of the family. It has no near ally in North

America. Kirby places its genus, which he calls *Melanargia*, next to what he calls *Oeneis*, Hübner, but which should read *Chionobas*, Boisduval.*

The imago and two varieties of the larvæ are figured in Humphrey and Westwood's Brit. But., and what purports to be the pupa, suspended by the tail from a leaf of grass. There is no resemblance at all between the pupa so figured and the true pupa. The description of the larva is limited to one line, "yellow-green, with a dark line down the back and on each side."

In Buckler's "Larvæ of British Butterflies and Moths," 1886, (a book which every working Lepidopterist ought to own, and published at a very low price, to wit: ten dollars for the two volumes so far issued, the first one covering the Rhopalocera); on plate iii. is figured the adult larva of *Galathaea* and the pupa. I have had this larva copied on my plate, Fig. 1. The text, which is by Rev. J. Hellins, represents the pupa as found on the sod, and unattached by the tail. This figure suggests an affinity to certain moths, noctuids especially,† and led me to wish to breed the species from the egg. M. Paul Chrétien, of Paris, kindly obtained eggs and sent them in a quill, in letter. They reached me 3rd Aug., 1886, thirteen days out, and hatched the next day. The larva, when about to come forth, cut the top in a circle, but not completely around, and raising this trap door made its way out, the door immediately falling back. The egg looked almost uninjured. The larva did not eat the egg shell. I mention this, because Mr. Hellins says the young larva "eats up its egg shell almost entirely," and he adds, "and thenceforward feeds on grasses," also, "it hibernates when very small." My larvæ hibernated at once from the egg, just as the larva of *Satyrus Alope* does. I put the little animals in the cellar, and later sent them to Clifton Springs, N. Y., to go in the refrigerating house there. They came back 21st March, 1887, in good condition. On 12th April, one passed the first moult. This larva

* There is no such genus properly as *Oeneis*, Hübner. There is a coitus of that name in Hübner's Verzeichniss, made up of mixed *Chionobas* and *Hipparchia*, and another one also made of the same two genera. By calling a coitus a genus, which it is not and was not intended to be, eliminating the *Hipparchias* from both these coitus, dovetailing together what remains, and calling the manufacture *Oeneis*, with a label Hübner, 1816, we get what is called the genus. The makers of lists and catalogues about 1870 hit on this contrivance, and many European authors have come to adopt the name *Oeneis*. In this country it has not met so favourable a reception. Perhaps the first definition of the genus *Oeneis* (and a definition is indispensable to recognition) was given by Mr. Scudder, in Syst. Rev., 1872; but *Chionobas*, Boisduval, 1832, has the priority.

† This figure resembles the larva of *Agrotis*, all but the terminal segment, which is Bombycid.

passed the second moult 23rd April, the third 4th May, and pupated 22nd May. I succeeded in getting but the one larva to pupation, and having accidentally injured the surface of the pupa, I put it in alcohol. The next year, M. Chrétien sent more eggs in same way. They hatched, and the larvæ went at once into lethargy, as before. They came back from New York, 6th April, 1888. I recorded that one was about to pass its first moult on 20th April, that two were at same time about to pass second, and two had already passed second on 5th June; that the appearance and attitudes of these larvæ are very much like noctuid larvæ. They are obese, sluggish, and spend most of the time lying on their backs or sides on the surface of the sod, the head and next segments bent in; or else they lie in a complete ring, the tail and head meeting. If resting on a stem of grass, the body is supported by the pro-legs only, the anterior segments arched, the feet not touching the stem. Now and then I found one feeding, but they did this mostly at night. On 13th June, one larva was evidently near pupation, by the pale hue of the skin and the disappearance of the lines. I record that it lies on its side and back between two stems, wedged in, its feet in the air. Next day it had got away from the stems and was lying on its back, much doubled up (Fig. 2). The following day it had pupated just where I had last seen it, unattached by the tail.

By 17th, I noticed that a second larva had fixed itself as I had recently seen one of *Erebia Epissoidea* do when about to pupate. It was nearly an inch clear of and above the sod, had drawn a few leaves of grass together by a few threads and rested among them upright, holding to the edge of a leaf by the prolegs, the dorsum much bent and turned to the left. An hour later the larva had loosed its hold and slid down, and was sticking upright in the sod, but had reversed its position, the dorsum now facing to the right. There it pupated, upright.

On 18th, another larva was lying on its back, like the first one mentioned. I had had a long search for it, and feared it had escaped, but by clipping the grass stem by stem, it was found low down in the sod, and there it pupated, 20th. The fourth also pupated, but among the roots, and was found only by pulling the sod in pieces. The fifth pupated in the night of 4th and 5th July. It had fallen off the bag which covered the plant, and was lying motionless on the earth. I laid it on its side among the leaves, and there it pupated, spinning no thread. From these pupæ I got five butterflies, the first one on 28th June, the last in middle of July.

Buckler figures what is called the third moult, and again the fourth moult. But, as I have said, my larvæ, in both years, passed three moults only. From the size of the figures I should say that both represented the same stage, one just after third moult, the other at maturity. Nothing is said of moults in the text. The young larva is described, then at length of 2.5 mm., and the mature larva at 30 mm. Mr. Hellins agrees with Westwood that the colour is variable, being buff, but sometimes green. All my larvæ were buff. It is stated that the larva "becomes full fed in June, and changes to pupa without suspending itself in any way, or making a cocoon," and the author adds, "I think it" (in natural state) "would hide itself, as my example did. I found they had got among the thick moss with which I had furnished the bottom of their cage, and apparently made little hollows for themselves by turning round." The pupa is described at length, but the curious "thoracic spiracle protector" is passed over so slightly that one would not suspect the nature or form of it, merely saying, "the pair of spiracles at the shoulders large and dark brown." *

The pupa which I had in 1887 was sent to Mr. Scudder, with no intimation of the species or its history, and he was asked what he thought it might be. His reply was: "The pupa you send seems very like one of the larger skippers, but I do not see any enlargement of the antennal tips, and think it must be a moth. The 'ear-like' projections are the thoracic spiracle protectors, which are entirely like this in *Tityrus*." As before said, *Eudamus Lycidas* pupa has the same sort of process.

I bred *Erebia Episoea* to imago in 1888, and found that here also the pupa was unattached. The end of the cremaster has a few short, straight bristles, both fewer and shorter than those of *Galathea*. Mr. Fyles bred *C. jutta*, and it pupated down in the moss, unattached. Mr. Scudder has described the mode of pupating of *C. semidea*, also down in the moss or among rocks, unattached, and neither of these have any bristles at all on the cremaster. This species is also described as curling up in a ring. *C. chryxus*, which I bred to pupa last year, is without bristles. It behaved like *Galathea*, pupating in the sod. Buckler figures

* The accompanying plate shows the larva of *Galathea*, Fig. 1, copied from Buckler; Fig. 2 shows the attitude on the sod when near pupation; 3 and 4, the pupa; 5 and 6, the last segment and cremaster, dorsal and side view, with the group of terminal bristles; 7, the single bristle; 8, the thoracic spiracle protector.

Erebia *Blandina* as pupating upright in the sod, also unattached; and I have copied this pupa on the plate, 9.

More remarkable still is Buckler's figure of Hipparchia *Semele* pupa (iv). It looks like *Tityrus* also, but is stouter, and the ventral side protrudes as in that species and *Galathea* (Fig. 10). Mr. Buckler's own account accompanies the plate. He dug the larva out of the sandy ground near the sea shore. "The captured larva, on being placed under a glass on a pot with its native food, immediately burrowed in the sandy earth, and the few times it was seen on the grass were always at night. On the 23rd June I searched for the pupa and found it in a hollow space a quarter of an inch below the surface, the particles of sand and earth slightly cohering together, and close to the roots of the grass, yet free from them. The pupa was obtuse, rounded, turned and smooth, and wholly of a deep mahogany colour." That is a strange recital! An Arctic *Chionobas* may be compelled by the severity of the climate to live within the moss and pupate there, but here is a species in the temperate regions, at the level of the sea, burrowing in the sand like a cut-worm, coming out at night to feed and returning to ground cut-worm fashion, and pupating under the surface in a manner common to many families of the Heterocera, even certain genera of Sphingidae.* Probably many other species and genera of Satyrinæ have larval habits such as I have related. Of the vast number of species but few are known in the early stages. Mr. Scudder says, p. 119: "We know of at least eight European species (besides *Galathea*), mostly referred to *Satyrus*, but some to *Epinephele* and *Parage* as well, the chrysalids of which are not suspended."

We have in America a butterfly, *Ridingsii*, provisionally placed in the genus Hipparchia, but which is not congeneric with *Semele*, the larva and pupa of which may have the form and habits of *Galathea* or even of *Semele*. I have its larvæ now hibernating.

The Satyrinæ are a very numerous family, with many natural genera, and most of these have numerous species. Kirby, in 1871, made 80 genera, and as many species have been described since, and of making of genera, natural and artificial, there is no end, I dare say there are 150 genera of some sort in the books to day. The butterflies are all or nearly

* "AGROTIS C. NIGRUM feeds by night on the tops of red clover, hides in the ground by day, pupates in a loose cocoon on top of the ground beneath rubbish, or even without any cocoon; but most Agrotids pupate in the ground. All the larvae of the genus have the habit of curling up."—French. I sent Prof. French one of these plates. He writes:—"No. 10 is precisely as I have seen the Agrotis pupate."

all feeble-bodied, feeble-winged, of weak and intermittent flight, and frequent woods and grassy spaces, loving the shade. "Distinguished by their peculiar flight, which is of a feeble, wavering, dancing character, and not long sustained ; neither do the insects rise far above the ground. Wallace, in writing of the species found on the Amazons, says he does not 'remember to have ever seen any species rise four feet from the earth, while the greater part of them *do not exceed as many inches.*' Some genera of the allied Morphinæ are said by Wallace to be 'truly crepuscular, never flying by day except when disturbed. * * * They remain hid during the day in the gloomiest shades of the forest.'"—Scudder.

As before set forth, here are four genera, *Arge*, *Hipparchia*, *Chionobas* and *Erebia*, in which the preparatory stages of species resemble in habits and form the Hesperiæ and certain moths. The last two are Arctic or boreal. The American *Erebias*, *Episodea* and *Magdalena*—this last represented on the shore of the Arctic Sea by *Fasciata*, (see But. N. A., vol. iii, pt. vii for this,) the two evidently being forms of one species—fly at the extreme north, or on the summits of the loftiest peaks of the Rocky Mountains. *Chionobas Semidea* a'so flies within the Arctic circle, as far north as Cumberland Island, and in Labrador, but there are isolated colonies at two other points, namely, the summit of the White Mountains of New Hampshire, and the high peaks of the Rocky Mountains. *C. jutta* is boreal, being found in Labrador ; but it reaches farther to the south than any other of its genus—to Quebec, Ottawa, and Bangor, Maine, where it flies at low elevations. *Arge* and *Hipparchia* are found inhabiting the temperate parts of Europe, and the first of these even crosses into Northern Africa. *Erebia Magdalena* and *Chionobas Semidea* live under the severest conditions. Mr. David Bruce says of *Magdalena* and its habitat : "It is found in the most uninviting looking spots it is possible for a naturalist to explore—black, barren, detached rocks, that look as if an immense peak had fallen and split into fragments ; hardly a blade of grass or a patch of lichen to relieve the utter desolation. I have never found this species but among such broken rocks, varying from 12,000 to 14,000 feet elevation. The sun gleams out, and awakened into activity by its beams, comes *Magdalena*, flitting leisurely, then suddenly taking an upward flight, it soars around. Another of same species springs up from the rocks, the usual skirmishing chase ensues for a few minutes, the sun is again obscured, and the insects disappear as if by

magic, and will not be seen until it is bright again. I have met with it from June 28th to July 18th." As Mr. Bruce searched for two seasons for this particular and exceedingly rare butterfly, this period of 20 days in which he found it, may be taken for the duration of the species in its imago stage. It is not probable that the life of one of the individual butterflies lasts one week. All butterflies die speedily after copulation (δ) and laying of eggs (φ), even in temperate regions. Many species in the same regions come from pupa with eggs mature, and copulation takes place almost at once, often before the wings of the female are dry, and in one well-known case, *H. Charitonias*, often before the imago is out of the pupa shell. We may be sure that nature would allow of no loss of time at 13,000 elevation. The existence of the species must depend on getting the eggs laid and protected. Mr. Bruce is of the opinion that there is an annual brood of the imago. I myself had thought there could be but one every two years, from my experience with allied larvæ, which are excessively slow in growth. My imagos of *Galathea*, as stated, showed 17 days between the emerging of the first and the last from pupa, and yet they were all hatched on same day. The 20 days spoken of by Mr. Bruce, as said above, represents the time in which the species was alive in the imago, not the life of one individual by any means. Spending therefore 51 weeks out of 52 in, or on, or under the ground as egg, larva, or pupa, one week in the imago, hiding among the rocks whenever the sun is obscured, and it is often obscured, or when fierce winds blow, and there must be very little time when a stiff breeze or a tempest is not blowing, the temperature every night, as Mr. Bruce tells us, as low as 30° Far., at the least, ice forming wherever there is a bit of water—is it possible to conceive an existence more unsuited for a creature dependent on sunshine than this *Magdalena* lives, imprisoned on those summits? Yet, the species must have lived so through untold ages.

For the history of *Semidea*, in New Hampshire, I will quote from Mr. Scudder, in his grand work, the Butt. N. E., pages 589 et seq: "These two butterflies (*Argynnis Montinus* and *Chionobas Semidea*) may be looked upon as the oldest inhabitants of New England, which followed the retreating ice sheet in its progress northward. They were the first of their tribe to fly over the barren fields of New England, where the earliest verdure began to follow the withdrawing ice, and moving with it, step by step, were at last, some of them, beguiled by the local glaciers in the

White Mountain region, long after the main glacial sheet had left these mountains far in its rear, and until connection with the main body was finally cut off." And quoting Mr. Grote on this species and its ancient history : "They advanced behind the deceiving local glaciers, step by step, up the mountain side, pushed up from below by the warm climate, which to them was uncongenial, until they reached the mountain peak. Here, blown sidewise by the winds, they patiently cling to the rocks ; or in clear weather, on weak and careful wing, they fly from stemless mountain-pink to blue-berry. Drawn into the currents of air that sweep down the mountain-side, they are forced downwards to be parched in the hot valleys below." Mr. Scudder continues : "It will be asked how it is possible that such delicate organisms as butterflies can maintain themselves *in such a bleak and inhospitable region* as the summit of the White Mountains, where a Greenlander would find it impossible to live in comfort, inasmuch as he would be exposed not merely to the cold, to which he is no stranger, but to the *fiercest and most biting winds, with an amount of humidity accompanying them which would seem to be almost fatal to existence.*" The author then speaks of the long larval period, during which the species is protected among the rocks and snow. Then continuing with the imago, it "invariably closes its wings back to back, and settles upon one side as if reclining, the *point of the wings away from the wind*, where it clings to the roughnesses of the rocks, and is seldom blown from its foot-hold. * * * In the imago state, *it cannot bear transportation so much as 3,000 feet vertically* to the base of the steeper slopes, at least if this transportation is effected in a rapid manner. *Indeed their efforts at flight under such circumstances are so pitiable* that it would seem very doubtful if the butterfly hurled deep down into the ravines by the fierce blasts which may at times catch it unawares could possibly remount the steep slopes. That such cases of destruction may occur with so feebled-winged a butterfly seems by no means impossible," etc.—the author relating how he had seen these insects swept over the cliff, etc. On page 145, we read also : "They can offer no resistance to the winds, and whenever they ascend more than their accustomed two or three feet above the surface of the ground * * * they are whirled headlong to immense distances," etc. He then relates how this butterfly escapes capture, "by edging its way afoot to the brink of a crevice," and dropping into same. And that he took three healthy females down the mountain on the railway train, and before half the descent was made they

were visibly affected, and by the time the tree line was reached—elevation 4,500 feet—they were gasping for air. At 2,800 feet, where he was staying, he thought them dead, and finally killed them, as they "gained no strength at the end of twelve hours." Doubtless similar careful observations and experiments with *Magdalena* would reveal a similar history. Mr. Scudder, p. 144, thinks it probable that the larval stages cover two winters. If so, the imago is biennial, as *C. Bore* of Europe, is said to be: "*Bore* hibernates twice as caterpillar and changes to chrysalis in May, in the winter quarters of the larva, free, in sand, between roots of grass under the surface of the ground."—But N. E., p. 126. That is, another species of this genus has the larval habits of a noctuid moth.*

The existence of *Magdalena* seemed as bad as bad could be, but these accounts of *Semidea* indicate a worse climate and therefore severer trials. These are two of the feeblest butterflies in the N. Am. fauna, and this sort of existence has endured at least since the glaciers retreated, and no one can guess how many years longer.† When we read that butterflies have come down from the Tertiary period unchanged, we may allow for *Semidea* a vast antiquity.

Members of the *Semidea* species dwell to-day within the Arctic circle, in Labrador, in the White Mountains of New Hampshire, and in the Rocky Mountains in Colorado, separated by vast distances. Mr. Scudder shows that the mountain colonies cannot exist in the low grounds, cannot even

* The history of *Semidea*, as related by Mr. Scudder, mostly from his personal observations, is worth the price of the whole work; and I recommend every person interested in butterflies to make it a part of their library without delay. I differ with Mr. Scudder radically about many things, the restriction of genera, the resurrection of obsolete names, the use of Hübner's Coitus and Tentamen names for genera and families, but in other important and essential points this work of his is and will forever remain unapproachable. The wealth of illustration is amazing, not only of the butterflies themselves, but of every part and organ of them, and what has never been attempted before except on a limited scale, the eggs and young larvae are shown in greatly magnified and admirably executed figures. In any future system the eggs and young larvae will form an important part. The time is coming when classification based on features of the imago alone will be thrown over, and the new arrangement will take consideration of all three of the preparatory stages. For these matters and the anatomical details, worked out with wonderful ability, and the life histories and distribution worked out with exceeding care, the Butterflies of New England will be a standard work, and no student can possibly get along without it. The edition is limited and the plates cannot be reproduced; therefore, I say to my friends, subscribe without delay.

† Mr. Geikie, in the Great Ice Age, p. 135, is of the belief that the last glacial period terminated 80,000 years ago, and began about 240,000 years ago.

descend the peaks; therefore there cannot have been communication between these branches since the retreating ice stranded the two southern colonies. Yet they are not distinguishable from one another. Examples from Labrador, even also from Ungava Bay, lat. 59° , are precisely like examples from the White Mountains and Colorado, and in fact these three branches of the species are not known to differ by a scale or a hair.

(*To be continued.*)

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(Continued from page 57.)

The following is a list of the entomological works of Dr. C. Zimmermann:—

1. Monographie der Carabiden, Erstes Stueck, Berlin and Halle, 1831, 8vo., pp. 8 and 76, contains the family Zabrodoes, five genera, with twenty-six species; review in *Oken Isis*, 1832, vol v., p. 539, vol x., p. 1117; extracted in *Silbermann Revue*, 1833, T. I., p. 45-47. The author's copy belongs to the library of the museum.

2. Monographia Amaroidum.—The work was interrupted by the author's voyage to America. The library of the museum possesses out of Zimmermann's own library a few sheets, printed in Europe in 1831, in two parts (proof sheets). The work is written in Latin. First part, p. 1-48 (three sheets), the general description of the family Amaroïdes:—I. de capitibus partibus, p. 5 (os, instrumenta masticandi); II. de trunci structura, p. 16 (collum, pectus, pedes, alae); III. de abdomenis segmentis, p. 31 (dorsum, venter, appendices); general division of the Adephaga and Carabidæ, p. 36, in 12 stirpes; de corporis partibus externis, p. 40, the plate (table 1) is not present, probably never printed, then follows the general description, p. 44, which gives the characteres sexuales (not finished), p. 48.

The second part (also not finished), *Monographia Amaroidum*, quotes the first part as:—Dispositio methodica nova Coleopterorum Adepha-

gorum. The characters of the family (p. 1) are followed by the systema of the family in twelve genera (p. 11).

1. *Leirus Megerle*, p. 12, twelve species, four new.
2. *Lioscelis*, Zimm., p. 31, nine species, two new (not yet finished). The third sheet is by error marked the fourth, and the pagination, p. 49-50, is wrong, instead of p. 33-48.

I have given purposely a detailed account of the two papers, only known by proof sheets, out of Zimmermann's library, as they contain, indeed, the most elaborate account of the general characters of the family. The description of the genera and of the species, as far as contained in the papers, is very detailed.

The paper on *Amara* is quoted in my *Bibliotheca II.*, p. 304, No. 2. It is in some way different from the Latin paper just described. It is published in German and translated in French, also the papers Nos. 3, 4 and 5. Besides those papers, after his death Dr. J. L. LeConte has published the two well known in the *Tr. Ent. Soc., Phila.*, 1868, on *Scolytidae*, and in 1869, synonymous notes on *Coleoptera*. Dr. J. L. LeConte's *Scolytidae*, p. 149, says:—"Among the MSS. of my deceased friend, Zimmermann, I find several partially completed memoirs, which contain not only systematic ideas of much value, but descriptions of many new species belonging to our fauna." Nevertheless he has published nothing more of them, and I am informed by Dr. J. H. Horn that nothing more of Zimmermann's papers was found after Dr. J. L. LeConte's death.

The following report is given in a letter from Zimmermann to Th. W. Harris, July 4, 1853 (in the library of Boston N. His. Soc.), it must not be forgotten that the letter was written before Chapnis and Candeze appeared:—

What I have observed about the beetles, grubs and their use for a methodical synopsis I will subscribe here with a few words only, for the thermometer rises again about 100° .

COLEOP. ERA.

A. Larvæ of 13 segments, full of folds, never with eyes.

1. *Petalocera* (= *Lamellicornia*), forming three sub-divisions, (*a*) containing *Oryctes*, *Melolontha*, *Copris*; (*b*) containing *Trox*, etc.; (*c*) containing *Lucanus*, etc.

2. Rhynchophora, (a) containing *Hylurgus*; (b) containing *Curculio*; (c) containing *Brenthus*.

B. Larvæ of 13 to 14 segments (head and prolegs included, each for one segment), without folds, with or without eyes.

3. Tetramera, (a) containing *Capricornia*; (b) containing *Bruchidæ*; (c) containing *Phytophaga*.

4. Pentamera, (a) containing *Sternoxa*, (a) *Buprestidæ*, (b) *Elateridæ*, (c) *Cebriónidæ*; (b) containing *Cleridæ*; (c) containing *Lycidæ*.

5. Heteromera.

C. Larvæ of 13 to 14 segments (mostly 14), above scaly, swift footed, always with eyes.

6. Adephaga.

7. Rhypophaga.

8. Brachelytra.

I have directed all my powers upon the investigation of the larvæ. Up to this day, however, I did not discover any more or better distinctive characters than those given above, and which appear to contain all the external characters worthy to be trusted, for you know already that numbers of them change their dress and form with each moulting. I may remind you here of the curious transformations of the larvæ of *Meloe*, as investigated in the Linnean Transactions, vol. xx. These little creatures appear as frequently delineated, at first with long legs for swift running, which is necessary for them in order to reach their final abode; having accomplished that they become by degrees fatter and more sluggish, whereby, curiously enough, the length of their legs decreases. The apparent difference between the larvæ of *Buprestis* and *Elater* may be explained upon similar necessities, for the body of the larvæ of *Buprestis* is soft and necessarily so, living as it does in hard and unyielding substances, whereas the body of the larvæ of *Elater*, which lives in more damp, soft and cold substances, will find its stiff and hard dress more comfortable than it would a softer one. The larvæ of *Buprestis*, as well as that of *Elater*, are of a structure sufficiently similar to be placed in the same great division (B), and more similarity was not necessary, for the structure of the beetles themselves had to decide their systematic station.

POPULAR AND ECONOMIC ENTOMOLOGY.—No. 2.

THE APPLE TREE TENT CATERPILLAR—THE AMERICAN LACKY MOTH
(*Clisiocampa Americana* HAR.)

BY JAMES FLETCHER, OTTAWA.

There are two kinds of caterpillars which every year commit serious depredations in our Canadian apple orchards, although they by no means confine their attentions to that tree. These are the larvæ of the American

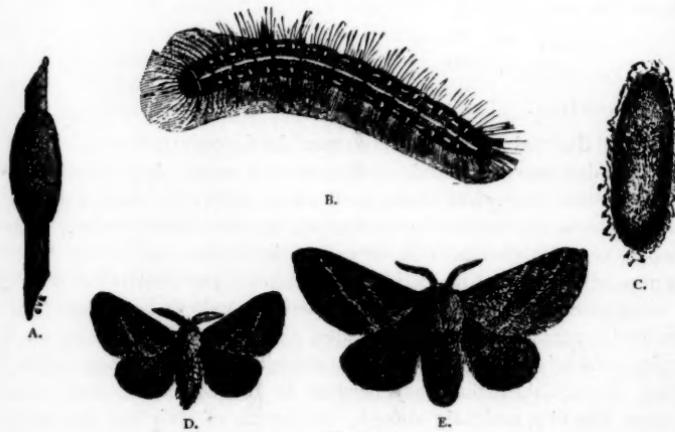


FIG. I.

and Forest Lackey Moths, two species of brown moths which frequently fly into houses at night during July, and draw attention by their headlong, reckless flight, dashing themselves against the ceiling and the walls, and very often finishing up by getting into the lamp chimney. Speaking generally, there is a great resemblance between these two insects in appearance and habits, and the same remedies are applicable for both; when examined carefully, however, they differ considerably in all their stages, and may be easily recognized. They belong to the *Bombycidae* or

Spinners, a family which contains the silkworm moths and several other thick-bodied, hairy moths, with large wings but small heads, bearing comb-like antennæ and having the mouth parts imperfect, or as in those now under consideration not developed at all. The caterpillars of the *Bombycidae* are usually hairy or tufted, and when full grown spin a cocoon for the protection of the short, thick chrysalids.

At Fig. 1 the different stages of the American Lackey Moth are given. This species appears in the perfect state in the beginning of July, about a week earlier than the other species referred to above, which is known by the name of the Forest Tent Caterpillar *C. disstria* Hüb. (*C. sylvatica* Har.)

The American Lackey Moth is a pretty species of a dull but rich reddish-brown colour, having the upper wings crossed obliquely by two clear, whitish, parallel lines. In rare instances these show faintly on the lower wings also. The fringes of the wings are chiefly of the same colour as the oblique lines. The space enclosed between the light lines is paler than the rest of the wings in the males, but of the same colour or rather darker in the females. On the under side, all four wings are crossed by a well-defined, irregular, whitish bar. The perfect insects having their mouth parts undeveloped partake of no food, but devote the whole period of their short lives to the perpetuation of their kind. As soon as they have paired and the females have laid their eggs they die. The eggs are deposited in rings upon the smaller twigs of various trees, usually within a short distance of the tips. Each egg-cluster contains from 200 to 300 eggs, which, when laid, are covered with a liquid glutinous substance which soon dries and cements them firmly together, and protects them from the weather.

A surprising point in the life history of these insects is that about a month after the eggs are laid, the young caterpillar is fully formed inside the egg and it remains in this condition all through the winter, only eating its way out from the egg in the following spring when the leaves expand. Immediately upon hatching the young caterpillars consume the glutinous covering of the eggs, and then lose no time in attacking the foliage. They at once begin the construction of their tent, which is a web of fine silk, spun in the nearest fork of the twig upon which they were hatched. This tent is increased in size as the caterpillars grow, and if left undisturbed is sometimes nearly a foot in diameter. The caterpillars are very regular in their habits, marching out in regular procession, each following close behind the

one in front of it. From the habit of the larvae of this genus of marching out to feed in bodies they are known in Europe as "Processionary Caterpillars." When their appetites are satisfied they return again to their tents to rest. They do not feed at night nor in stormy weather. They usually do not leave their tent until after nine in the morning, and have all returned before sundown. They are generally inactive in the middle of the day.

When full grown the caterpillars are two inches in length, and beautifully marked with black, white, blue, yellow and brown in the pattern shown in Fig. 1., B. The continuous stripe down the back is white, and serves as a distinctive mark by which this species can be known at once from the Forest Tent Caterpillar—Fig. 2—which has this dorsal stripe broken up into spots. This latter also differs in not constructing a tent, but merely spins a mat of silk on the side of a tree, or upon one of the large branches, on and near which it lives, more or less, in community; but it has not the same social habits as its relative. Just before they spin their cocoons, the caterpillars wander about very much, seeking for a suitable place. The cocoon, Fig. 1., C., is greenish yellow, and contains a powdery material



FIG. 2.

like finely ground sulphur. The moths emerge in about eighteen or twenty days after the cocoon is made.

Remedies.—The most successful remedies with these insects all come under hand-picking. During the winter or early spring the egg-clusters can be easily collected and destroyed; they are always laid upon the small twigs and near the tips, so that if a dull day be chosen they can be easily detected against the sky, and can then be cut off and burnt, when, of course, the trees are exempt from attack, until eggs are laid again next year. If this precaution is neglected, the nests, which are conspicuous objects before the foliage is fully expanded in spring, must be cut off and destroyed. An invasion from neighbouring trees can be prevented by tying a strip of cotton-batting round the trunk, which the caterpillars have difficulty in climbing over.

THE LARVA OF *LIMACODES INORNATA*, G. & R.

BY HARRISON G. DYAR, RHINEBECK, N. Y.

Larva.—Elliptical and much flattened, the sides rising slightly to two dorsal ridges, only a little elevated, these ridges diverging somewhat towards the anterior and posterior portions of the body. Around the outline of the body is a series of flattened pointed projections for the last eight segments, furnished on their sides with fine, short hair. These projections occur on each segment after the fifth, the two on the last segment somewhat longer than the others, and directed nearly straight backwards. Colour green, a reddish line on the angulated outline of the anterior segments; the dorsal ridges marked with a narrow yellow line, which is interrupted between two dorsal yellow spots with red centres. These spots are conspicuous though small.

Food Plants.—Maple, wild cherry, hickory, etc. Like most of the *Cochliinae* a very general feeder.

A good figure of this insect is to be found in Harris's Entomological Correspondence,* and in the text Dr. Harris says: § [The larva is] "in form somewhat like an *Oniscus*, being oval and flattened, with lateral tooth-like appendages fringed with hairs. General colour green, with lateral rows of minute, ocellated, spots, each pupillated with a black dot; a dorsal row of dark spots, with two of a rich scarlet colour * * * This insect does not sting."

The difference between this larva and that of *Limacodes scapha* Harris† is very marked. While *L. scapha* is a thick larva, resembling a lump of some substance adhering to the leaf; the present species, as above stated, is much flattened, and furnished with its remarkable tooth-like projections. In fact, before the imagines of *L. inornata* were developed, I had no idea that the insect could be congeneric with *L. scapha*.

Two males, raised from these larvae, differ somewhat from the original description by Grote and Robinson,‡ so that, to them, the name of "inornata" hardly applies. In this form the secondaries are somewhat

* Entomological Correspondence of T. W. Harris, edited by S. H. Scudder, 1869. Plate II., Fig. 7, and Plate III., Fig. 6, § *ibid*, page 176.

† Figured, *ibid*, Plate III., Fig. 8.

‡ Lepidopterological Contributions page 22, from Ann. Lyceum Nat. Hist., of New York, 1886.

darker above than in the typical insect, while the primaries are variegated by a ferruginous brown basal shading, continued narrowly along the internal margin and connecting with a similarly coloured band, extending, on its inner side, parallel with the external margin, but its outer edge starts from the outer margin above the internal angle and runs obliquely inward, so that the band ends in a point before reaching the costa. The upper part of this band, as well as the outer part of the basal shading, has a purplish tint. Fringe dark brown.

I should judge this to be the ordinary ♂ of *L. inornata*, in New York. A single ♀, also raised from these larvæ, fits the description above referred to.

CORRESPONDENCE.

ARZAMA OBLIQUATA.

Dear Sir: In reply to Mr. Moffat and Mr. Kellicott, I wish to say that both of these gentlemen are mistaken in saying that the larvæ of *Arzama obliquata* go to the shore in the fall of the year to stay over the winter. On the 25th of November last my friend, Chas. P. Mackisney, of Arlington, N. J., and I took a walk through the meadows at Arlington, which cover from fifteen to twenty square miles. We did not find any signs of *Arzama* except in one place about two hundred feet square, and there in every reed we cut we found a larva, but we had to cut below the surface of the water to get them. I went out to the meadows again to-day (the 22nd of February) in order to get some larvæ to send to Mr. Moffat and Mr. Kellicott, and I found some about four hundred feet from the shore, where I had to cut the ice to get to the bottom of the reeds. I got four larvæ and shall send them to these gentlemen in order that they may see for themselves that I was right in my statements (C. E., xx., 119). I also wish to state that if they require further evidence I should like them to come to New Jersey, and I will take them to a place where they can get a car load of cat-tail reeds with larvæ in them throughout the whole winter. I do not think that Dr. Riley is correct in saying that the female lays her eggs in masses. I have always found them deposited singly, and I do not think it likely that they would be laid otherwise, because it would be impossible for a number of larvæ to live in one reed.

H. H. BREHME, Newark, New Jersey.

ARZAMA OBLIQUATA.

Dear Sir: On reading Mr. Kellicott's communication in CAN. ENT. for February, 1889, I learn that his observations concerning the habits of *Arzama obliquata* G. & R. larvæ, do not agree with mine. Up to the 26th of January of the present year I held the same opinion as he does, and I was not a little bit surprised on hearing of its being a winter feeder. Requiring some lining for a few packing boxes which I was preparing to send by mail, I had occasion to go to the marsh for some stalks (commonly known as rushes, but by botanists, I suppose, as *Typha*), which make a convenient substitute for cork. The very first stalk that I cut showed that larvæ had been at work. This at once brought to my mind the recent communications of which Mr. Kellicott writes, so I began an investigation and was much surprised at the result. Besides a number of empty pupæ and a mature larva (which I always find in the form of a loop, with one end shorter than the other) at rest for the winter, down in the thick part of the stalk, I found three immature larvæ at full length up in the small part and surrounded by evidence of recent feeding. During my nine or ten years of collecting, I have raised both *Arzama obliquata* and *diffusa* from mature larvæ found on shore in old wood and other rubbish, mostly every year. Some I have found as early as November 3rd, and others in every month until May. Having always found them pretty plentiful on shore, I was of the opinion that it was their habit always to come there to transform, but my observations on the above date convince me that those I had hitherto found were only wanderers, while the main body remain at home to undergo their transformation. As for their being single brooded here I agree with him. I have found two or three moths late in July, but those I should say came from larvæ which passed the winter in the immature state, rather than from eggs laid that season.

March 9th, 1889.

JAMES JOHNSTON, Hamilton, Ont.

NOTES.

We are glad to learn that Mr. John B. Smith, of the National Museum, Washington, has been appointed State Entomologist of New Jersey. He will enter upon his new duties on the first of April, and will reside at New Brunswick, N. J. While we congratulate the State upon securing the

services of so eminently capable an entomologist, we trust that Mr. Smith will find his new work congenial and satisfactory, and its accessories lucrative and comfortable.

The following amendment has been made to the Agriculture and Arts Act during the recent session of the Ontario Legislature :—"Section 67 of the said Act is amended by adding thereto, after sub-section (2), the following : ' Provided, however, that the Entomological Society of Ontario shall, at its annual meeting, group into five divisions the agricultural divisions enumerated in Schedule A. to this Act, and shall elect one person from each of such five divisions (who shall be a resident of the division he represents) as directors of the said Society.' "

The New York Academy of Sciences is making an effort to erect a suitable monument in Trinity Church-yard in memory of the great ornithologist, John James Audubon. About \$900 has been collected, but the plans accepted call for from \$6,000 to \$10,000. It is earnestly hoped that each scientific society in America will contribute an average amount of \$100 through its members, and thus enable the enterprise to be at once completed. Each subscriber of a dollar or more will receive a copy of a print from Cruickshank's celebrated portrait of the great naturalist suitable for framing. Remittances from our members may be sent to Mr. W. E. Saunders, 240 Central Ave., London ; or to Dr. N. L. Britton, Columbia College, New York.

The following is the list of the officers of the Kent Scientific Institute, of Grand Rapids, Mich., for 1889, which is incorporated for the promotion of scientific education and the establishment and maintenance of a natural history museum :—President, E. S. Holmes ; Vice-President, W. A. Gruson ; Recording Secretary, C. W. Carman ; Corresponding Secretary, E. S. Holmes ; Treasurer, C. A. Whittimore ; Director of the Museum, W. A. Gruson ; Curator, C. W. Carman ; Librarian, E. L. Morely. Board of Directors :—Wright L. Coffinberry, W. A. Gruson, Samuel L. Fuller, E. S. Holmes, J. W. Jones, C. A. Whittimore. Officers of the Board :—Chairman, W. A. Gruson ; Secretary, E. S. Holmes ; Treasurer, C. A. Whittimore.

Mailed April 8th.

